AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1.   (original) A abnormality diagnosing apparatus used in a machine equipment including a rotating or sliding part relative to a stationary member, the abnormality diagnosing apparatus comprising:

a detecting portion fixed to the rotating or sliding part or the stationary member and including at least one vibration system sensor of a vibration sensor, a sound sensor, an ultrasonic sensor and an AE sensor; and a temperature sensor; and

a signal processing portion for determining a state of the part from a detecting signal outputted by the detecting portion;

wherein the signal processing portion determines presence or absence of a abnormality of the part, or presence or absence of the abnormality of the part and a degree of a damage based on a combination of a measured result by the vibration system sensor and a measured result by the temperature sensor.

2.   (original) The abnormality diagnosing apparatus according to Claim 1, wherein measured values by the vibration system sensor and the temperature sensor or rates of changes of the measured values over time are calculated at least by once;

wherein the signal processing portion includes a abnormality determining portion for determining presence or absence of the abnormality, or presence or absence of the abnormality determining portion and the degree of the damage by comparing the measured values or the rates of the changes with predetermined values.

3.   (original) A abnormality diagnosing apparatus used in a machine equipment including a rotating or sliding part relative to a stationary member, the abnormality diagnosing apparatus comprising:

a driving unit for driving the rotating or sliding part;

a detecting portion fixed to the part or the stationary member and including at least one of at least one vibration system sensor of a vibration sensor, a sound sensor, an ultrasonic sensor and an AE sensor; and a temperature sensor; and

a signal processing portion for determining a state of the part from a detecting signal outputted by the detecting portion;

wherein the signal processing portion diagnoses a abnormality of the part based on the detecting signal of a vibration or a temperature by the detecting portion when the part is moved by inertia within a predetermined speed zone when a power of the driving unit is turned off.

4.   (original) A abnormality diagnosing apparatus used in a machine equipment including a rotating part relative to a stationary member, the abnormality diagnosing apparatus comprising:

a driving unit for driving to rotate the part;

a detecting portion fixed to the part or the stationary member and including at least one of:

at least one of vibration system sensor of a vibration sensor, a sound sensor, an ultrasonic sensor and an AE sensor; and

a temperature sensor; and

a signal processing portion for determining a state of the part from a detecting signal outputted by the detecting portion;

wherein the signal processing portion diagnosis a abnormality of the part based on the detecting signal of a vibration or a temperature by the detecting portion when the part is rotated within a rotational speed zone 100 min^{-1} or faster and 1500 min^{-1} or slower.

5.   (original) The abnormality diagnosing apparatus according to Claim 4, wherein the signal processing portion diagnoses the abnormality of the part based on the detecting signal of the vibration or the temperature by the detecting portion when the part is rotated by inertia within the rotational speed zone without turning off a power of the driving unit.

6   (currently amended) The abnormality diagnosing apparatus according to Claim 3 ~~or 5~~,
wherein the driving unit is used by repeatedly turning on and off the power of driving unit,
and the part is movable by inertia when a power of the driving unit is turned off.

7.   (currently amended) The abnormality diagnosing apparatus according <u>Claim 3</u> ~~to any~~
~~one of Claims 3, 5 and 6~~, wherein a state of moving the part by inertia when a power of the
driving unit is turned off is detected based on an OFF signal of the driving unit.

8.   (currently amended) The abnormality diagnosing apparatus according to <u>Claim 3</u> ~~any~~
~~one of Claims 3 through 7~~, further comprising:

        a rotational speed sensor for detecting a rotational speed of the driving unit,

        wherein the abnormality of the part is diagnosed in cooperation with a detecting
signal of the rotational speed by the rotational speed sensor and the detecting signal of the
vibration or the temperature by the detecting portion.

9.   (currently amended) The abnormality diagnosing apparatus according to <u>Claim 1</u> ~~any~~
~~one of Claims 1 through 8~~, wherein the signal processing portion includes:

        a comparing and checking portion for comparing a frequency component owing to
damage of the part calculated based on the rotational speed signal and a frequency component
of measured data based on the signal detected by the vibration system sensor; and

        a abnormality determining portion for determining presence or absence of the
abnormality of the part and specifying a damaged portion.

10.   (original) The abnormality diagnosing apparatus according to Claim 9, wherein the
signal processing portion includes:

        a filter processing portion for removing an unnecessary frequency band from a signal
waveform detected by the vibration system sensor;

        an envelope processing portion for detecting an absolute value of the waveform which
after being subjected to a filter processing transmitted from the filter processing portion; and

a frequency analyzing portion for analyzing a frequency of the waveform transmitted from the envelope processing portion.

11.　(original) A abnormality diagnosing apparatus used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal; and

a signal processing portion for:

analyzing a frequency of a waveform of the electric signal;

sampling a peak of a spectrum larger than a reference value calculated based on the spectrum provided by analyzing the frequency;

comparing and checking a frequency between the peaks and a frequency component owing to a damage of the part calculated based on a rotational speed signal or a moving speed signal; and

determining presence or absence of a abnormality of the part and an abnormal portion based on a result of the checking.

12.　(original) The abnormality diagnosing apparatus according to Claim 11, wherein the signal processing portion subjects the detected signal to at least one of an amplifying processing and a filter processing and the signal processing portion subjects thus processed waveform to an envelope processing.

13.　(original) A abnormality diagnosing apparatus used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal; and

a signal processing portion for determining presence or absence of a abnormality and an abnormal portion of the part based on a frequency of a shockwave in which a waveform of the electric signal per unit time exceeds a threshold, and a rotational speed signal or a moving speed signal.

14.   (original) The abnormality diagnosing apparatus according to Claim 13, wherein the signal processing portion subjects the waveform of the electric signal to a filter processing and converts the waveform to an all time rectified waveform,

whenever the waveform exceeding the threshold, the signal processing portion makes a waveform which is converted so as to hold the waveform at a value exceeding the threshold for a predetermined period of time according to the rotational speed signal, and

the processing portion informs a possibility of bringing about the abnormality in the part according to a number of times in which the waveform exceeds the threshold per a predetermined rotational number.

15.   (original) The abnormality diagnosing apparatus according to Claim 14, wherein the signal processing portion determines true or false of the possibility of bringing about the abnormality in the part according to the number of times in which the waveform converted to hold the threshold exceeds the threshold per the predetermined rotational number by a plurality of times of statistical determinations.

16.   (currently amended) The abnormality diagnosing apparatus according Claim 11 to any one of Claims 11 through 15, wherein the signal processing portion is executed when a rotational speed of the part is substantially constant.

17.   (original) A abnormality diagnosing apparatus used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal; and

a signal processing portion for:

analyzing a frequency of a waveform of the electric signal,

comparing and checking a frequency component of a measured spectrum data provided by analyzing the frequency and a frequency component owing to the part with a variable allowable width; and

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of the checking.

18.   (original) A abnormality diagnosing apparatus used in a machine equipment including a rotating part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal; and

a signal processing portion for:

analyzing a frequency of a waveform of the electric signal,

comparing and checking a frequency component of a measured spectrum data provided by analyzing the frequency and a frequency component owing to the rotating part with an allowable width; and

determining presence or absence of a abnormality and an abnormal portion of the rotating part based on a result of the checking;

wherein a zone having un upper limit and lower limit, both of which are calculated from the rotational speed of the rotating part and dimensional specification of the rotating part, is divided into at least one zone, a central value in the divided zone is calculated, and the allowable width is set as at least a zone having an arbitrary size which is given with respect to the central value, and

wherein the signal processing portion compares and checks the frequency component of the measured spectrum data and the frequency component owing to the rotating part at least at each of the allowable width.

19.   (original) The abnormality diagnosing apparatus according to Claim 18, wherein the allowable width is given to at least one of a case where the rotating part includes a plurality of rotating parts having different dimensional specification design from each other; and a case where the rotational speed of the rotating part is varied.

20. (currently amended) The abnormality diagnosing apparatus according to Claim 17 ~~any one of Claims 17 through 19~~, wherein the allowable width is increased as the frequency component becoming a high frequency component.

21. (currently amended) The abnormality diagnosing apparatus according to Claim 17 ~~any one of Claims 17 through 20~~, wherein the allowable width is increased or decreased in accordance with a frequency band of the frequency component.

22. (currently amended) The abnormality diagnosing apparatus according to Claim 17 ~~, or 18~~, wherein the allowable width is increased or decreased in accordance with the rotational speed.

23. (original) A abnormality diagnosing apparatus used in a machine equipment having at least one rotating or sliding part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal; and

a signal processing portion for:

analyzing a frequency of a waveform of the electric signal;

comparing and checking a frequency component of a measured spectrum data provided by analyzing the frequency and a frequency component owing to the part; and

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of the checking;

wherein a reference value used for the comparing and checking is calculated based on a limited frequency range of the measured spectrum data.

24. (original) A abnormality diagnosing apparatus used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing apparatus comprising:

at least one detecting portion for outputting a signal generated from the machine equipment as an electric signal;

a signal processing portion for analyzing a frequency of a waveform of the electric

signal; comparing and checking a frequency component of a measured spectrum data

provided by analyzing the frequency and a frequency component owing to the part; and

determining presence or absence of a abnormality and an abnormal portion of the part based

on a result of the checking;

a storing portion for storing a result of a diagnosis diagnosed by the signal processing

portion;

an outputting portion for outputting the result of the diagnosis in a predetermined

style; and

a report forming portion for forming a report from an outputted result outputted by the

outputting portion based on at least one program.

25.   (currently amended) The abnormality diagnosing apparatus according to <u>Claim 11</u> any

one of Claims 11 through 24, wherein the detecting portion includes an integrated type

sensor, in which at least one of the temperature sensor for detecting the temperature of the

machine equipment and a rotational speed sensor for detecting the rotational speed of the

rotating part, is installed in a single case in addition to a sensor for detecting a vibration

generated from the machine equipment.

26.   (original) The abnormality diagnosing apparatus according to Claim 25, wherein the

machine equipment includes a bearing constituting the rotating part and a bearing box for

fixing the bearing;

wherein the integrated type sensor is fixed to a flat portion of the bearing box.

27.   (currently amended) The abnormality diagnosing apparatus according to <u>Claim 1</u> any

one of Claims 1 through 26, further comprising data transmitting unit which transmits a result

of a determination by the signal processing portion.

28.   (currently amended) The abnormality diagnosing apparatus according to <u>Claim 1</u> any

one of Claims 1 through 27, further comprising a microcomputer which carries out a

processing by the signal processing portion, and a processing of outputting the result of the determination to a control system.

29.   (currently amended) The abnormality diagnosing apparatus according to Claim 1 ~~any one of Claims 1 through 28~~, wherein the machine equipment is a bearing unit for a railway vehicle.

30.   (currently amended) The abnormality diagnosing apparatus according to Claim 1 ~~any one of Claims 1 through 28~~, wherein the machine equipment is a bearing unit for a windmill.

31.   (currently amended) The abnormality diagnosing apparatus according to Claim 1 ~~any one of Claims 1 through 28~~, wherein the machine equipment is a bearing unit for a spindle of a machine tool.

32.   (original) A abnormality diagnosing method used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal;

analyzing a frequency of a waveform of the detected signal;

a step of sampling a peak of a spectrum larger than a reference value calculated based on the spectrum provided by the analyzing step, and comparing and checking a frequency between the peaks and a frequency component owing to a damage of the part calculated based on a rotational speed signal or a moving speed signal; and

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of checking at the comparing step.

33.   (original) A abnormality diagnosing method used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal; and

detecting presence or absence of a abnormality of the part based on a frequency of a shockwave in which a waveform per a unit time period of the electric signal exceeds a threshold, and a rotational speed signal or a moving speed signal.

34.   (original) A abnormality diagnosing method used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal;

analyzing a frequency of a waveform of the detected signal;

comparing and checking a frequency component of a measured spectrum data provided at the analyzing step and a frequency component owing to the part with a variable allowable width; and

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of the checking at the comparing step.

35.   (original) A abnormality diagnosing method used in a machine equipment including a rotating part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal;

analyzing a frequency of a waveform of the detected signal;

setting at least one allowable width such that: a zone having an upper limit and lower limit, both of which are calculated from the rotational speed of the rotating part and dimensional specification design of the rotating part, is divided into at least one zone, a central value in the divided zone is calculated, and the allowable width is set as at least a zone having an arbitrary size which is given with respect to the central value

comparing and checking a frequency component of a measured spectrum data provided by analyzing the frequency and a frequency component owing to the rotating part at each of at least one of the allowable width; and

determining presence or absence of an abnormality and an abnormal portion of the rotating part based on a result of the checking at the comparing step.

36.   (original) A abnormality diagnosing method used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal;

analyzing a frequency of a waveform of the detected signal;

comparing and checking a frequency component of a measured spectrum data provided at the analyzing step and a frequency component owing to the part; and

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of the checking at the comparing step;

wherein a reference value used in the comparing and checking is calculated based on a limited frequency range of the measured spectrum data.

37.   (original) A abnormality diagnosing method used in a machine equipment including at least one rotating or sliding part, the abnormality diagnosing method comprising the steps of:

detecting a signal generated from the machine equipment and outputting the signal as an electric signal;

analyzing a frequency of a waveform of the detected signal;

comparing and checking a frequency component of a measured spectrum data provided at the analyzing step and a frequency component owing to the part;

determining presence or absence of a abnormality and an abnormal portion of the part based on a result of the checking at the comparing step;

storing a result of a diagnosis provided by at least by one of the analyzing, comparing and determining steps;

outputting the result of the diagnosis in a predetermined style; and

forming a report from a result of an output outputted by the outputting step based on at least one program.